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12/8/67

MEMORANDUM FOR: SA/E/D/ORD

SUBJECT : Requirement for Human Engineering Capability Within ORD.

REFERENCE : [redacted] 25X1

1. In accordance with your suggestion I've outlined below my apprehension concerning the lack of Human Engineering capability within ORD, the required characteristics of an individual(s) to provide this capability, and a possible role in the organizational structure. By necessity this will have to be very brief, for to completely describe the Human Engineering field and functions (which are in a state of confusion) would require a book. I'll be happy to discuss it at any time and, as was suggested, will include a brief of this in the program call. Incidentally, I'm not recruiting for a holy crusade on this subject but do feel that a Human Engineering capability would make a worthwhile contribution to the ORD structure.

2. There is no adequate definition of Human Engineering. The field carries a hodge podge of labels reflecting the prejudices and

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"father figures" with whom a particular group wish to identify. The usual backbone is either medicine, experimental psychology or engineering. Consequently, we have such terms as: human engineering, human factors engineering, biophysics, human factors, engineering psychology, erognomics, biotechnology, etc., with very loose logical distinctions between them. In view of this situation, let's not worry about definitions but merely for convenience use the term Human Engineering in consideration of ORD requirements in this area.

3. The definition of the Element of Human Factors which we carry in our Program Planning is as follows: [redacted] 25X1

[redacted] 25X1

25X1 [redacted] Without any reflection on the merits of this work, or some of the projects that I have initiated in what might be called human factors, these activities are not what I envisage as a requirement for human engineering in ORD. What I do have in mind is an individual(s) who is not primarily responsible for monitoring individual projects, but rather is the ORD Human Engineering expert and serves as a "task officer", with responsibility and authority (not consultation) on system and sub-system R&D projects sponsored by various Divisions within ORD. One might qualify this by restricting it to those systems or sub-systems in which

humans are involved. However, there is very little activity that would be eliminated by this restriction. It is largely a matter of the degree of human involvement rather than an all-or-none situation.

4. The assigned or assumed duties of the human engineer are as varied and confusing as the definition. Depending upon the particular employer he is considered as responsible for: providing fundamental human capability data for use by the engineer in equipment design; design or selection of knobs and dials for display with some responsibility for manual control systems; the "interface" between man and machine (a cliche -- what is the "interface in driving an automobile in traffic?"); systems analysis in terms of the human factors; selection, training, instruction manuals and other soft ware; test and evaluation with "man in the loop" (another cliche); etc. Once again, as in the case of a def inition, I do not believe it worthwhile to attempt to arrive at an ironclad Position Description but would rather merely consider how and what a human engineer might profitably contribute to the ORD function.

5. Without using specific projects as examples, there are numerous systems and sub-systems being developed under ORD sponsorship which appear to a greater or lesser degree to involve human engineering.

As a matter of fact, in several of these projects, human engineering is at the very heart of the problem. In projects to be undertaken in the future, I would consider the role of the Human Engineer somewhat as follows: (a) The Project engineer would state the requirements for his proposed system (not Agency requirements, but a delineation of what the system is supposed to do, where, how fast, what payload, what accuracy of control, covert or overt, levels of tolerance at various points in the subsystems, pass-fail criteria for system success, etc.). At this point the human engineer, working with the Project Engineer and his staff, would assist in writing system specifications for contractor proposals. He would not only have responsibility for human engineering specifications, but would be expected to know the proposed "workings" of the entire system. Incidentally, the human engineer within ORD would review all projects at the time of their Agency approval and on the basis of his appraisal and discussions with the Project Engineer would determine if, and to what extent, human factors would play a role in the total system. He would not wait to be called, or not called, by the Project Engineer for Human Engineering assistance. Of course, the Project Engineer would have ultimate authority if he decided that human engineering was not required.

(b) The human engineer would assist in evaluation of contractor proposals and would have as much authority to reject a proposal on the basis of inadequate human factors consideration as the electronic engineer would have in rejecting a proposal because of poor electronic considerations. (c) The Human Engineer would be the primary point of contact on all matters concerning human factors both with the Project Engineer and the contractor. He would have the authority to design, direct, and monitor all human engineering effort. However, all action decisions and instructions to the contractor would be via, and with the approval of the Project Engineer. (d) Assists and approves contractor experimental design for any human engineering experimentation required to evaluate sub-systems; i.e., can the operator maintain required efficiency with this data rate input and with these particular display-control dynamics? The Human Engineer will have responsibility for monitoring the actual experimentation and evaluation of results. Reports directly to the Project Engineer and to the contractor indirectly via the Project Engineer. (e) He monitors all contractor effort in meeting the human engineering specifications. These efforts would vary with complexity and nature of the system but a few of the areas of responsibility would include:

1. Functional Analysis of the Man in the System.

2. Functions Allocation (who does what, or can a machine do better).

3. Decision Analysis (operator decisions as opposed to mere manipulation).

4. Activity Task Analysis (specifically what are the stimulus-response requirements).

5. Flow and Time Analysis (sequence of actions and rate).

6. Workspace Allocation (layout and anthropometric considerations).

7. Operator Ambient Environment.

8. Personnel hazards, Protective Equipment and Escape.

9. Operator Communication Requirements.

10. Design for Operator Trouble Shooting and Maintenance.

11. Operator Selection and Training.

12. Operator software.

13. Other

(f) The Human engineer would be notified of all scheduled meetings concerning the project, other than those restricted to budget considerations. (g) Although, for organizational purposes the human engineer(s) would be attached to the appropriate Division within ORD, when working on a project sponsored by another Division he would report to and take all action steps via the Project Engineer of that

Division. Of course, he would keep his own Division chief informed of his activities and that Division Chief would have the authority to say "cease and desist".

6. The above is my conception, in very brief outline form, of the role and requirements for human engineering in ORD. Incidentally, I have a hunch that system development in other organizations within the Agency could profit as much as ORD from the human engineering contribution. It should be recognized that the activity described above is quite different from specific human factors projects in which the human engineer is also the project engineer. The same person(s) could do both but they are quite different functions.

7. Remaining consistent, the personnel academic training and experienced prerequisites for performing the human engineering function is as confused as the definition and responsibilities. There are approximately 23 academic insitutions in the country that issue either an MA or a Ph.D. in what is loosely described as human factors. The sponsoring departments are about equally divided between engineering and psychology. The academic curriculum usually reflects the emphasis of the Department. A few have joint programs between departments. Probably about ten of the 23 pro-

grams would provide individuals with the academic credentials to meet ORD requirements.

8. Without going into detail regarding emphasis and subject matter, the human engineer for ORD should have: a comprehensive knowledge of experimental psychology; a working knowledge of engineering with emphasis on electronics; conversing knowledge capability in physics, mathematics, and physiology; some experience in systems analysis development, test, and evaluation; and most important, sufficient maturity, thick skin, and sense of humor to withstand cooperation apathy, paternalism, verbal aggression, distain and occasional suggestions to engage in immoral relations with the moon.

9. If a decision is made to undertake a program similar to that outlined above, I would be happy to assist in appropriate recruitment.

10. The above constitutes my casual thoughts. However, if it is decided to take action in this area, Enclosure 1 is a very informal addendum which might be considered for long-range planning. Personally, I have no ego involvement in the program. However, if I should play a role in the implementation I would like to retain sufficient time and energy to devise and monitor certain scientific ef-

forts in the human factors area rather than devoting exclusive time to oiling the wheels for system development in other divisions.

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Enclosure 1

ORD HUMAN ENGINEERING CAPABILITY ACTION PLAN

1. Reach ORD agreement that Human Engineering Capability is desired.

2. Compose a formal long-range plan for implementation.

3. Presentation of plan to S&T for approval.

4. Assuming approval, initiation of a "sales" campaign within ORD by [redacted] and guest speakers of national renown in the human engineering area.

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5. Hire a GS-11 or 12, probably at the MA level, with the best academic and experience we can obtain at that Grade (Mr. X)

6. [redacted] and Mr. X survey current and proposed ORD projects in terms of human engineering requirements.

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7. Compile this information in a way that will allow determination of the probable human engineering workload, function, and position in the organizational structure. Assume this information indicates a need for at least three full-time individuals, which is a minimum estimate if we include NPIC.

8. [redacted] and Mr. X select, with Project Engineer concurrence, those projects to which Human Engineering effort would provide the greatest contribution to, within time and personnel limitations. Devote required effort.

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9. Assume initial acceptance by ORD divisions, some evidence of profitable contribution to ongoing projects, and unfulfilled requirements from the prior survey. Establish on paper a Human Engineering Section with defined mission, goals, personnel requirements, and growth potential. Recruit to establish the Human Engineering Branch at a level which just barely meets ORD requirements (assume [redacted] Mr. X, + 2).

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10. Over a two-year period allow the Human Engineering Branch to demonstrate its competence with enthusiastic acclaim throughout ORD. Assume this desirable outcome is achieved.

11. Establish a Human Factors or Behavioral Sciences Division. The structure and mission of this Division cannot be precisely specified in advance. However, a possible organization and program goals might be as follows:

Behavioral Sciences Division

[ ]

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Human Engineering Branch [ ]

Function:

(a) H.E. Assistance to ORD systems
(b) H.E. assistance to other intra - Agency system development projects.

Human Performance Branch [ ]

Function:

(a) Human Factors project activity not necessarily related to system development and with a behavioral orientation.

NOTE: The Human Engineering activity has been described previously. The project activity of the Human Performance Branch would be concerned with overt human performance capability or with data taken "outside the skin". It would not be directly concerned with physiology, biochemistry, bionics, physiological indices of stress, how the eye and ear discriminate, other "inside the skin" activities, or animal studies. These would continue to be the province of BSD and MBSD.

The dichotomy of the Behavioral Sciences Division into Human Engineering and Human Performance Branches is largely arbitrary. The personnel should be selected so that they function equally well in either Branch. In fact, the real reason for having a Performance Branch is to provide an opportunity for the Human Engineer, who is always working on someone else's problems without an opportunity for scientific recognition, to gain some personal ego enhancement. If this opportunity were not part of a long-range goal it would be extremely difficult to recruit competent personnel to exclusively perform a human engineering function.

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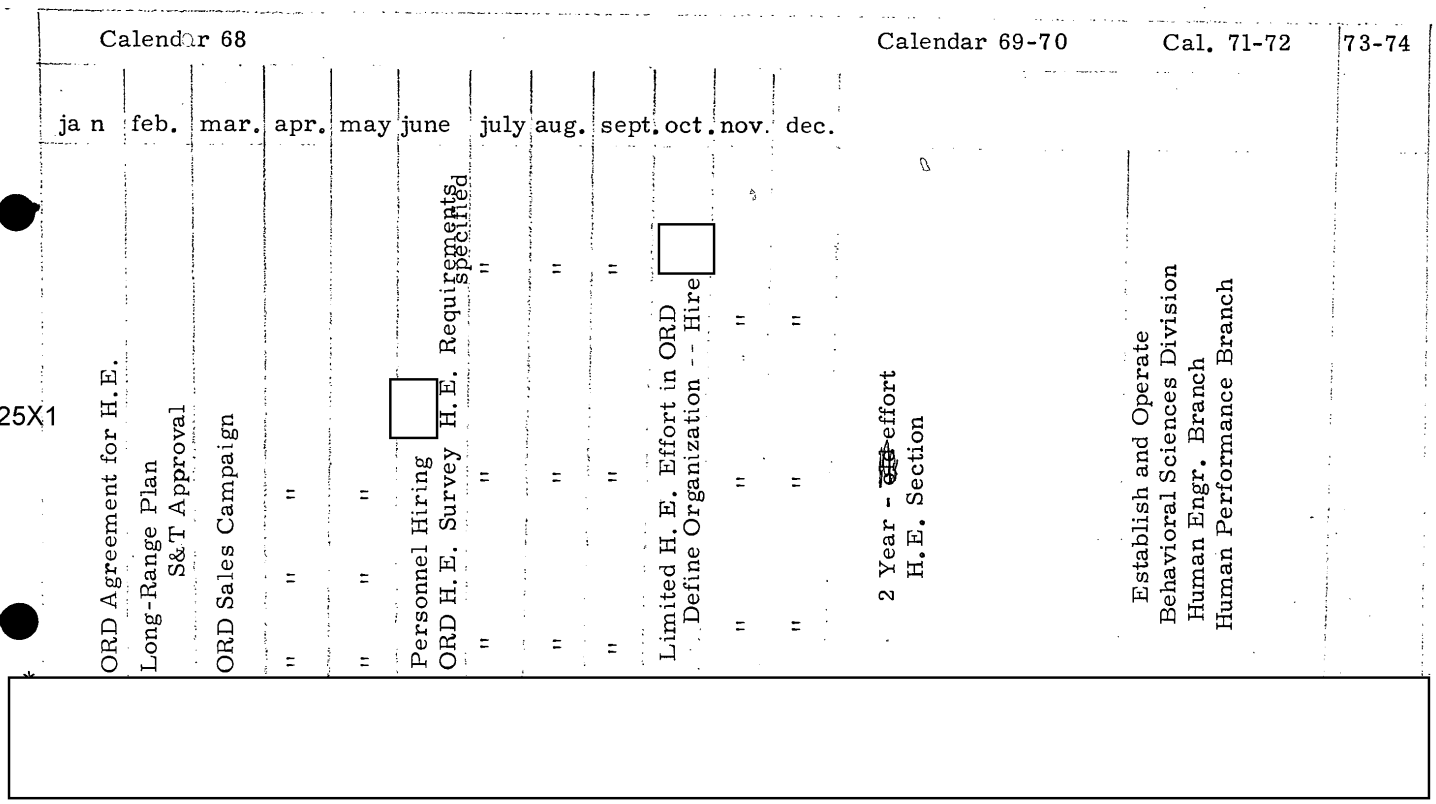
## Human Engineering Milestone Chart

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Numbers refer to items listed on Action Plan

Fiscal Requirements; 1969 70 71 72 73 74

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NOTE: The program plan is structured in such a way that it can be discontinued at any point without significant fiscal loss. There is no advanced investment. Significant contribution must be demonstrated at each step before the next step is authorized and financed.

1. Present and future prospects of Behavioral Sciences

2. ORD level of effort - manpower, money

3. Consumer is about 50% DDP

4. ORD Role
   (a) translate Ops requirement to technical requirement
   (b) experimental design
   (c) Validation
   (d) dollars
   (e) technical staff

5. DDP role
   (a) problem of identification (ops requirement)
   (b) Coordination
   (c) R&D requirement
   (d) operational feasibility studies in-house -----

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TITLE: MEDICAL AND BEHAVIORAL PROGRAM

GOAL : HUMAN FACTORS AND BEHAVIOR

AREA : STRESS MEASUREMENT AND INTERPRETATION

HUMAN BEHAVIOR

HUMAN FACTORS



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